

1 **MODULAR EXPANSION JOINT SYSTEM**
2 **July 18, 1994**

3 **General Requirements**

4 1.01 Description

- 5
- 6 A. This item of work shall consist of furnishing material, services, labor, tools,
7 equipment, and incidentals necessary to design, fabricate, inspect, test, and
8 install the expansion joint system as specified.
9
- 10 B. The expansion joint system consists of a modular, multiple seal joint that
11 will allow movements as shown and noted in the Plans.
12
- 13 C. The expansion joint system shall be as shown and noted in the Plans.
14
- 15 D. The expansion joint system shall be continuous across the full width of the
16 roadway and up into the traffic barriers as shown in the Plans.
17

18 1.02 Acceptable Manufacturers

19

20 Only manufacturers who have successfully completed the fatigue testing as
21 described in Section 3.05 of this Special Provision will be permitted to design and
22 supply modular expansion joints. The following manufacturers are known to have
23 completed fatigue testing in accordance with the requirements of this Special
24 Provision:

- 25
- 26 1. The D.S. Brown Company
27 P.O. Box 158
28 300 E. Cherry Street
29 North Baltimore, Ohio 45872-0158
30 Tel. (419) 257-3561 Fax (419) 257-2200
31
- 32 2. Watson Bowman ACME Company
33 95 Pineview Drive
34 Amherst, New York 14228
35 Tel. (716) 691-7566 Fax (716) 691-9239
36

37 1.03 Submittals

- 38
- 39 A. Within 10 days of contract award the Contractor shall submit the name of
40 the expansion joint manufacturer to the Engineer. Once the name of the
41 manufacturer is submitted to the Engineer, the Contractor shall not change
42 the expansion joint manufacturer unless the manufacturer indicates that
43 they cannot supply the expansion joint in accordance with the requirements
44 of this Special Provision.
45

46 The expansion joint manufacturer shall have at least three years experience
47 in designing and manufacturing modular expansion joints. The Contractor
48 shall provide written certification of the manufacturer's experience. This
49 certification shall include the bridge locations, governmental agency/owner,
50 name, address, and telephone number of the owner's/agency's
51 representative.
52

53 The shop plans and calculations shall be prepared, reviewed, and approved
54 by a registered professional engineer and shall carry his/her signature and

1 seal. The registered professional engineer shall be employed by the
2 manufacturer.

3
4 B. Shop plans

5
6 1. The Contractor shall submit details of the expansion joint system to be
7 used together with installation and waterproofing plans to the Engineer
8 for approval prior to fabrication of the joint. The shop plans shall be
9 submitted in accordance with Section 6-03.3(7). These plans shall
10 include but not be limited to the following:

- 11
12 a. Plan, elevation, and section of the joint system for each
13 movement rating and roadway width with dimensions and
14 tolerances.
15
16 b. Complete details of all components and sections including all
17 materials incorporated into the expansion joint system.
18
19 c. All ASTM, AASHTO, or other material designations.
20
21 d. Method of installation including sequence, setting relative to
22 temperature, anchorage during setting, installation details at
23 curbs, and installation of seals.
24
25 e. Corrosion protection system.
26
27 f. Requirements for storage of joint system and details of
28 temporary support of joint for shipping, handling, and job site
29 storage.
30
31 g. Design calculations for all structural elements including all
32 springs, and bearings. The design calculations shall include
33 fatigue design for all structural elements, connections, and
34 splices. All welded splices shall be shown on the shop plans.
35
36 h. Welding procedures shall be in accordance with the current
37 AASHTO/AWS D1.5 Bridge Welding Code.
38
39 i. Replacement of parts subject to wear shall be allowed for in
40 the design. The Contractor shall submit for the Engineer's
41 approval, a written maintenance and part replacement plan
42 prepared by the joint manufacturer. This plan shall include a
43 list of parts and instructions for maintenance inspection,
44 acceptable wear tolerances, methods for determining wear,
45 procedures for replacing worn parts, and procedures for
46 replacing seals.
47
48 j. Modification to blockout reinforcing steel to accommodate the
49 expansion joint system.

50
51 C. Certificates of Compliance

52
53 1. At the time of shop plan submittal, the Contractor shall submit to the
54 Engineer the following certifications for review and approval.
55

- 1 a. Manufacturer's certificate of compliance with the AISC Quality
2 Certification Program, Category III, Major Steel Bridges.
- 3
- 4 b. Certification that welding inspection personnel are qualified
5 and certified as welding inspectors under AWS QC1, Standard
6 for Qualification and Certification of Welding Inspectors.
- 7
- 8 c. Certification that personnel performing nondestructive testing
9 (NDT) are qualified and certified as NDT Level II under the
10 American Society for Nondestructive Testing (ASNT)
11 Recommended Practice SNT-TC-1a.
- 12
- 13 2. The Contractor shall submit the following test reports, certificates, and
14 samples for review, testing, and approval within four weeks of the shop
15 plan approval.
- 16
- 17 a. Manufacturer's certificate of compliance for all
18 polytetrafluorethylene (TFE) sheeting, TFE fabric, and
19 elastomer.
- 20
- 21 b. Certified mill test reports for all steel and stainless steel in the
22 expansion joint assemblies.
- 23
- 24 c. Certified test reports confirming that the springs and bearings
25 meet the design load requirements.
- 26

27 1.04 Shipping and Handling

- 28
- 29 A. The expansion joint system shall be delivered to the job site and stored in
30 accordance with the manufacturer's written requirements and as approved
31 by the Engineer.
- 32
- 33 B. Lifting locations, lifting mechanisms, and temperature setting devices shall
34 be shown in the shop plans. Lifting mechanisms, temperature setting
35 devices, and construction adjustment devices shall not be welded to the
36 centerbeams or edge beams.
- 37
- 38 C. Damage to the joint system during shipping or handling will be cause for
39 rejection of the joint system.
- 40
- 41 D. Damage to the corrosion protection system shall be repaired to the
42 satisfaction of the Engineer.
- 43

44 **Material Specifications**

45 2.01 Structural Steel

- 46
- 47 A. Structural steel shall conform to the requirements of AASHTO M 183,
48 AASHTO M 223 Grade 50 or AASHTO M 222. Aluminum components shall
49 not be used.
- 50

51 2.02 Stainless Steel

- 52
- 53 A. Stainless steel shall conform to ASTM A 240 Type 304.
- 54

55 2.03 Polytetrafluorethylene (TFE)

- 1
2 A. TFE shall be 100% virgin teflon, woven TFE fabric, or dimpled TFE
3 conforming to the requirements of Section 18.8.1, Division II - Construction,
4 AASHTO Standard Specifications for Highway Bridges, 15th Edition and
5 current interim Specifications.
6

7 2.04 Expansion Joint Seals

8
9 The maximum size of the expansion joint strip seals shall be 3 inches or 80 mm.
10 "Box" seals or seals utilizing double webs will not be acceptable. Seals shall be
11 continuous and no splices will be permitted.
12

<u>Property</u>	<u>Test Method</u>	<u>Range of Values</u>
15 Hardness, 16 Durometer A	ASTM D2240	55 -70
18 Tensile Strength	ASTM D412	2000 psi minimum
20 Elongation at break	ASTM D412	250%
22 Compression Set, 23 at 72 hr. at 212° F.	ASTM D395	40%

24
25 2.05 Bolts, Nuts, Washers

- 26
27 A. Bolts and other hardware shall conform to the requirements of AASHTO M
28 164 Type 1 or 2 and shall be galvanized in accordance with AASHTO M
29 232 and Section 9-06.5(3).
30

31 2.06 Other Materials

- 32
33 A. Other materials shall meet the requirements of the Standard Specifications
34 and this Special Provision.
35

36 **Design Requirements**

37 3.01 General

- 38
39 A. The expansion joint seals shall not protrude above the top of the joint. Split
40 extrusions may be used at upturns at all curbs.
41
42 B. The elastomeric or urethane springs and bearings shall be designed so that
43 they are removable and replaceable. The removal and reinstallation of the
44 strip seal shall be easily accomplished from above the joint with a 1 1/4 inch
45 minimum gap width. These operations shall be capable of being done with
46 a one lane partial closure of the roadway.
47
48 C. The expansion joint system shall be designed to be watertight.
49
50 D. The effect of vertical and horizontal rotations, and transverse movements
51 shall be accounted for in the design.
52

53 3.02 Limit States Fatigue Wheel Loads
54

1 A. The centerbeams or transverse seal separation beams, including edge
 2 beams, support bars, bearings, and other structural elements shall be
 3 designed for the simultaneous application of the vertical and horizontal limit
 4 states fatigue wheel load ranges shown below:

5		
6	Limit States Fatigue	Limit States Fatigue
7	Vertical Wheel Load Range	Horizontal Wheel Load Range
8	(Normal to the	(Parallel to the
9	Roadway Surface)	Roadway Surface)
10		
11	26.0 kips/wheel	8.0 kips/wheel

12
 13 These limit states fatigue wheel load ranges include impact and shall be increased
 14 for the effect of roadway grades when the grade exceeds 4 percent. For roadway
 15 grades 4 percent or less, the loads shown can be used without modification.

16
 17 Alternate wheel load ranges may be used providing that the absolute magnitude of
 18 the wheel load ranges (e.g. sum of positive and negative loads along the same axis)
 19 is not less than the total wheel load ranges shown above.

20 21 3.03 Application of Limit States Fatigue Wheel Load Ranges

22
 23 A. For the design of the centerbeams and edge beams, two vertical and
 24 horizontal load ranges described above shall be applied simultaneously,
 25 spaced 6 feet apart, and applied at the roadway surface as a rectangular
 26 patch loading. The rectangular patch shall have a 9 inch length in the
 27 direction of traffic and a 20 inch width perpendicular to the direction of
 28 traffic. When the roadway grade exceeds 4 percent, the additional
 29 horizontal component due to grade shall be added to the horizontal limit
 30 states fatigue wheel range described previously.

31
 32 As shown below, the percentage of the loads applied to the centerbeams
 33 and edge beams is based on the midrange position of the seals and the
 34 width of the top flange of the centerbeams.

35		
36	Width of Top Flange of	
37	Centerbeams or Edge Beams	Percentage
38		
39	2.25" or less	40
40	3.125"	50
41	4.0"	60

42 43 3.04 Fatigue Limit States Design

44
 45 A. The expansion joint structural steel members, connections both welded and
 46 bolted, and steel components shall remain free of cracks after 100 million
 47 cycles, which represents the endurance limit. Fatigue testing is necessary
 48 to establish the limiting or allowable stress range, $F_{sr \text{ test}}$, at the endurance
 49 limit of 100 million cycles.

50
 51 The fatigue limit states equation shown below shall be satisfied for all
 52 expansion joint steel structural members, connections both welded and
 53 bolted, and steel components.

54
 55 $(0.5)f_{sr \text{ calc}} \leq F_{sr \text{ test}}$ Fatigue Limit States Equation

where

$f_{sr \text{ calc}}$ = calculated stress range based on the simultaneous application of two sets of vertical and horizontal limit states fatigue wheel ranges at 6 feet spacing.

$F_{sr \text{ test}}$ = allowable limit states fatigue stress range at the endurance limit of 100 million cycles.

3.05 Fatigue Testing

Constant amplitude fatigue testing shall be performed to determine $F_{sr \text{ test}}$, (the allowable limit states fatigue stress range at 100 million cycles) for all structural members, connections both welded and bolted, and components.

The allowable limit states fatigue stress range at 100 million cycles shall be based on a survival probability of 95 percent.

The test loadings shall be applied so that the vertical and horizontal loadings are applied simultaneously. Testing shall be performed so that the horizontal load is 20 percent of the vertical load.

Fatigue testing shall be done by an independent testing laboratory. The following individuals have indicated that they have the facilities to perform the fatigue testing.

A. Prof. Ferdinand Tschemmernegg, Head
Institute of Steel and Timber Structures
Faculty of Civil Engineering and Architecture
University of Innsbruck
Technikerstrasse 13
A-6020 Innsbruck
Austria
tel (0 512) 748-4360 FAX (0 512) 748-4363

B. Prof. Charles W. Roeder
Department of Civil Engineering
233 More Hall FX10
University of Washington
Seattle, WA
tel (206) 543-6199 FAX (206) 543-1543

C. Dr. John W. Fisher
ATLSS Research Center
Lehigh University
117 ATLSS Drive, H Building
Bethlehem, PA 18015
tel (215) 758-3535 FAX (215) 758-5553

Fabrication

4.01 General

A. The expansion joints shall be fabricated in accordance with the dimensions, shapes, designs, and details shown in the approved shop plans and in conformance with the Standard Specifications and the Special Provisions.

- 1 B. All the expansion joints shall be fabricated by the same manufacturer.
2
3 C. Seal retainer clips, if welded to the seal separation or edge beams, shall be
4 welded continuously on the top side and on the bottom side.
5

6 4.02 TFE Sliding Surface
7

- 8 A. The TFE shall be bonded under controlled conditions and in accordance
9 with written instructions provided by the manufacturer of the TFE.
10
11 B. After completion of the bonding operation, the TFE surface shall be smooth
12 and free from bubbles.
13

14 4.03 Stainless Steel Sliding Surface
15

- 16 A. The stainless steel sliding surface shall have a finish of 20 microinches
17 (RMS) or less.
18
19 B. The stainless steel sheet shall be seal welded all around to the steel
20 backing plate by the tungsten-arc welding process in accordance with the
21 current AWS specifications. The stainless steel sheet shall be clamped
22 down to have full contact with the steel backing plate during welding. The
23 welds shall not protrude beyond the sliding surface of the stainless steel.
24

25 4.04 Corrosion Protection
26

- 27 A. All steel surfaces, except the surfaces under stainless steel or those to be
28 bonded to TFE or those in direct contact with the seal, shall be protected
29 against corrosion by one of the following methods:
30
31 1. Zinc metallized in accordance with the Special Provision
32 **METALLIC COATINGS**.
33
34 2. Hot-dip galvanized per AASHTO M 111.
35
36 3. Painted in accordance with the Special Provision **APPLICATION**
37 **OF PAINT**. The color of the final coat shall be Washington Gray
38 (revised). The surfaces embedded in concrete shall be painted
39 only with a shop coat of inorganic zinc silicate paint.
40

41 4.05 Installation
42

- 43 A. To aid in assuring proper installation of each expansion joint system in the
44 field, the Contractor shall have available at the job site, the services of a
45 qualified installation technician who is a full time employee of the
46 manufacturer of the expansion system to be installed in this project.
47 Recommendations made by the expansion joint manufacturer's installation
48 technician, on or off the job site, and approved by the Engineer shall be
49 adhered to by the Contractor.
50

51 The joint manufacturer's installation technician shall advise the Contractor
52 and certify to the Engineer that the proper installation procedures were
53 followed. All certifications to the Engineer shall be in writing, signed and
54 dated by the manufacturer's installation technician.
55

1 B. The modular expansion joint system shall be installed in strict accordance
2 with the manufacturer's instructions as approved in Section 1.03 of this
3 Special Provision, and the advise of the manufacturer's installation
4 technician. The permanently installed joint system shall match exactly the
5 finished roadway profile and grades.

6
7 The expansion joint system shall be water tested after installation. Leaks
8 shall be repaired to the satisfaction of the Engineer.
9

10 C. The Contractor shall take precautions to protect the joint systems from
11 damage. Special care shall be exercised at all times to ensure protection of
12 the expansion joint system. Prior to installation of the joint, the blockout and
13 supporting system shall be protected from damage and construction traffic.
14 After installation of the joint system, construction loads shall not be allowed
15 on the joint. The Contractor will be required to bridge over each joint. The
16 method of bridging over each joint shall be submitted to the Engineer for
17 approval.
18

19 D. The modular expansion joint system shall be set to the proper width for the
20 ambient temperature at the time of setting. This information is indicated in
21 the Plans.
22

23 Any mechanical devices, supplied by the joint system manufacturer, used to
24 set the joint system to the proper width will remain the property of the
25 manufacturer. When no longer required, the devices shall be returned to
26 the manufacturer.
27

28 E. All forms and debris that tend to interfere with the free action of the
29 expansion joint system shall be removed.
30

31 4.06 Watertightness 32

33 A. After each joint has been installed and completed, it shall be flooded for a
34 minimum of one hour to a minimum depth of 3 inches. If leakage is
35 observed, the joint system shall be repaired at the Contractor's expense.
36 The repair procedure shall be prepared by the manufacturer and submitted
37 to the Engineer for approval. After repairs are made, the joint shall be
38 retested for leakage.
39

40 4.07 Inspection 41

42 A. Three levels of inspection must be satisfied before the expansion joints are
43 accepted. These are: Quality Control Inspection, Quality Assurance
44 Inspection, and Final Inspection. The manufacturer shall provide for both
45 Quality Control and Quality Assurance Inspection. The Contractor shall
46 provide access for the Final Inspection. The three levels of inspection are
47 described below:
48

49 1. Quality Control Inspection 50

51 During the fabrication process of all major components, the
52 manufacturer shall provide full time Quality Control Inspection to
53 ensure that the materials and workmanship meet or exceed the
54 minimum requirements of the contract. Quality Control Inspection
55 shall be the responsibility of the manufacturer's quality control
56 group which shall be independent of the fabrication group.

1
2 2. Quality Assurance Inspection
3

4 Quality Assurance Inspection shall be performed by an
5 Independent Inspection Agency provided by the manufacturer.
6 The Independent Inspection Agency, the proposed Quality
7 Assurance Inspection Program, and the forms to be used for the
8 Quality Assurance Inspection Program shall be submitted to the
9 Engineer for approval prior to the start of fabrication. Quality
10 Assurance Inspection is not required to be full time inspection, but
11 shall be done at all phases of the manufacturing process. The
12 frequency of inspection shall be included in the Quality Assurance
13 Inspection Program.
14

15 3. Final Inspection
16

17 Upon arrival at the job site and prior to installation, the expansion
18 joints will be inspected by the Engineer. The Contractor shall
19 provide an area for the Final Inspection of the expansion joints.
20

21 Immediately prior to installation, the joint system will be inspected
22 by the Engineer, for proper alignment, and complete bond between
23 the neoprene seals and the steel, and proper stud placement.
24 There shall be no bends or kinks in the joint system steel (except
25 as necessary to follow the roadway grades). There shall be no
26 straightening of such bends or kinks. Any joint system exhibiting
27 bends or kinks (other than those shown on the approved shop
28 plans) shall be removed from the work site, and replaced by a new
29 joint system, at the expense of the Contractor. Neoprene seals
30 not fully bonded to the steel shall be fully bonded at the expense of
31 the Contractor. Studs shall be inspected visually, and shall be
32 given a light blow with a hammer. Any stud which does not have a
33 complete end weld, or does not emit a ringing sound when struck a
34 light blow with a hammer, shall be replaced. Studs located more
35 than one inch, in any direction, from the location shown on the
36 shop drawings, shall be carefully removed and a new stud placed
37 in the proper location. All stud replacements shall be at the
38 expense of the Contractor.
39

40 4.08 Acceptance
41

- 42 A. The expansion joints must satisfy each of the three levels of inspection
43 described in Section 4.07 of this Special Provision before they will be
44 accepted. Expansion joints which fail any one of the three levels of
45 inspection shall be replaced or repaired at no expense to the Contracting
46 Agency to the satisfaction of the Engineer. Any proposed corrective
47 procedure shall be submitted to the Engineer for approval before corrective
48 work is begun.
49
- 50 B. As outlined in Section 3.05 of this Special Provision, fatigue testing of all
51 structural members, splices, connections, and components shall be
52 performed. Any revised details or material substitutions developed after the
53 initial fatigue testing shall be retested in accordance with Section 3.05 of
54 this Special Provision.
55

56 It is the Contractor's responsibility to ensure that the manufacturers have
57 completed fatigue testing in accordance with the requirements of Section

1 3.05 of this Special Provision for the joint supplied. Any additional costs
2 and/or time delays incurred as a result of additional testing or delays in
3 obtaining an acceptable expansion joint manufacturer shall be the
4 Contractor's responsibility.
5
6 **Payment**
7 5.01 The lump sum contract price for "Modular Expansion Joint System -
8 Superstr." shall be full pay for all materials, labor, tools, equipment, design,
9 testing, inspection, services, and incidentals necessary to furnish and install
10 the expansion joint systems as specified.